Long Island Botanical Society

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Novel Ecosystems, Invasion and the Forgotten Food Web

Marilyn J. Jordan, Ph.D., Conservation Biologist, mj.eco.phd@gmail.com

What are novel ecosystems?

You probably are familiar with novel ecosystems even though you don't know them by the name recently bestowed on them by scientists. Think about successional woodlands that have grown up on abandoned farm fields, forests draped with Oriental bittersweet (*Celastrus orbiculatus*) and thick with Japanese barberry (*Berberis thunbergii*), grasslands covered by exotic grass species, and streams and impoundments lined with *Phragmites* and covered with floating invasive plants (Figure 1).

What do these novel ecosystems have in common? They resulted from human actions that degraded "wild" areas or from abandonment of intensively cultivated or grazed lands (Figure 2). Human-caused ecosystem degradation includes introduction of new (sometimes invasive) species and loss of original species; pollution of air, water and soil; nitrogen deposition from the atmosphere or from application of fertilizers; altered hydrology; dispersal barriers including roads and dams; overharvesting; global changes in climate and ocean acidification. These ecosystems are also called "emerging ecosystems" and "no-analog ecosystems."

Lands with ongoing human management such as cultivated agricultural fields, managed gardens and landscapes, and active tree plantations are not considered novel ecosystems by most ecologists but it is not always easy to draw the line.

Novelty can be measured as the degree of change from a carefully defined "unaltered" reference historical condition. But this raises the following questions. How far back in time? What aspects of history are important? How do we know past conditions? Do any truly unaltered ecosystems remain today? How might today's ecosystems change in the future? Historical knowledge helps us understand how systems work and provides guidance for management, though the reference condition is not a rigid template or end goal. Spoiler alert – Yes ecosystems

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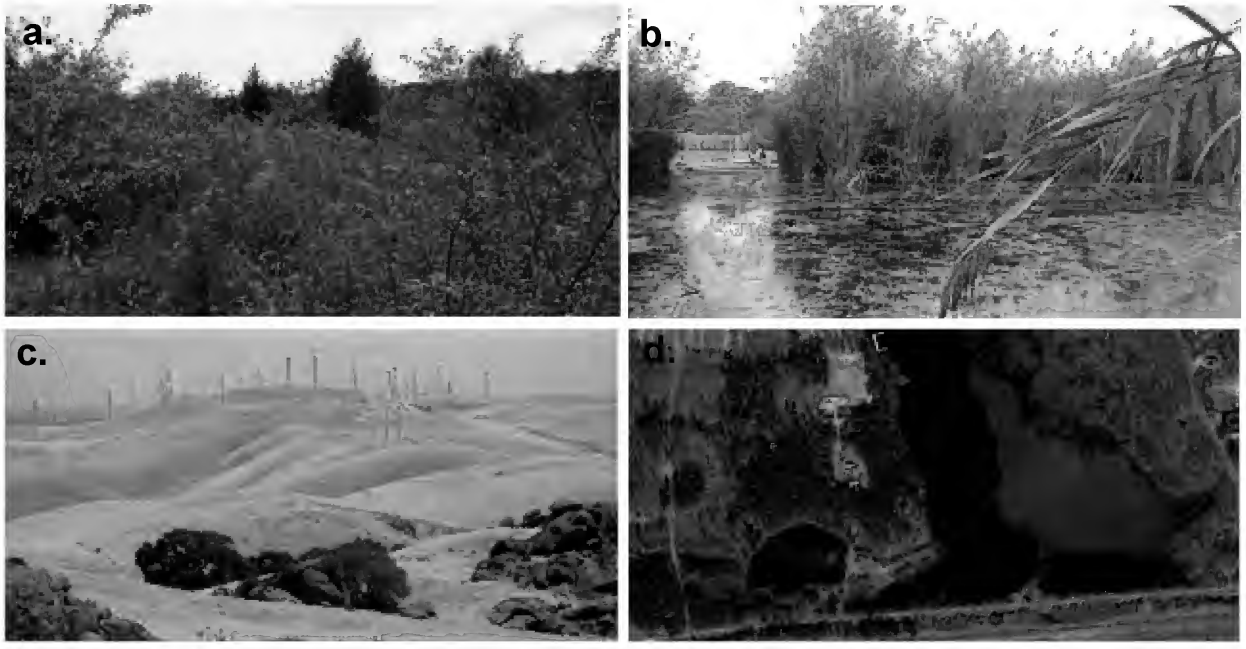

Figure1. Examples of novel ecosystems. a. Successional woodland on an old potato field, Froelich Farms County Park, Huntington NY. b. Invasive plants (*Phragmites australis, Cabomba caroliniana*) on the Peconic River, Calverton, NY. c. California grasslands dominated by nonnative grasses. d. Impoundment on the Carmans River (Hards Lake in Southaven Co. Park, Yaphank, NY). [Photos a., b., c. by M. Jordan; d. from Google Earth.]

Long Island Botanical Society

Founded: 1986 • Incorporated: 1989

The Long Island Botanical Society is dedicated to the promotion of field botany and a greater understanding of the plants that grow wild on Long Island, New York.

Visit the Society's Web site
www.libotanical.org

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Society News

LIBS gratefully acknowledges donors. The society would not exist without the support of its members, and LIBS takes this opportunity to express sincere appreciation to the following members who recently gave very generous year-end donations: Dottie and Bill Titus, Larry Liddle, Louise Harrison, Tony Lauro, Mike Laspia, Marilyn Jordan, Margo Myles, Mary Maran, Tom Fiore, Ray Welch, Sabin Family Foundation, Lenore Swenson, Kathy Gaffney, Bob McGrath, Betsy Gulotta, Barbara Conolly, and the Planting Fields Foundation.

Mark your calendars! New York State is celebrating its first Invasive Species Awareness Week July 6-12, 2014! Schedule an awareness activity to help spread the word, not the species! Contact Hilary Smith at hsmith@tnc.org

Field Trip Coordinator Needed: 2014 will be Mike Feder's fourth and final year as LIBS field trip coordinator and his replacement is being sought. If you think you would like to help organize field trips next year, please contact president Eric Lamont.

Volunteers Needed: Coffin Woods Preserve (North Shore Wildlife Sanctuary) in Locust Valley has just been awarded a grant to eradicate an infestation of hardy kiwi vine (*Actinidia arguta*). Can you volunteer to help monitor the eradication at this site throughout the 2014 growing season? Volunteers will document new growth, remove plants as they begin to regrow, and determine if further efforts are needed. An hour or so on a Saturday would be so appreciated. Please contact Al Lindberg at ajlindberg@verizon.net or Carol Johnston at johnfjohnston2@optonline.net.

LIBS Speakers' Registry: If you are willing to present a talk or lead a field trip for garden clubs, libraries, and other groups, please join the LIBS Speaker's Registry. For details, see the previous issue of the LIBS Newsletter, or contact Margaret Conover at margaret.conover@gmail.com.

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In Memoriam: It saddens me to report the passing of LIBS member and Muttontown Preserve naturalist Frank Hurley, on Feb. 8, 2014. Many of you knew Frank as a program leader at Muttontown, or as the "Bee Man" whose passion for beekeeping made him a popular speaker. If you've attended LIBS meetings at the Muttontown Nature Center, Frank was the one who always had the chairs set up, coffee pot filled, and the projector and screen ready to go. His easygoing manner with the public and volunteers often belied his many skills. In his career as Chief Chemist at Grumman Aerospace, he worked on the Lunar Module among other notable projects. After his retirement he joined the staff of Muttontown Preserve, doing everything from maple sugaring to mechanics, writing spreadsheets to teaching school groups. Frank could go from fixing the preserve tractor in the morning to playing the harmonica at a volunteer luncheon in the afternoon. We're really going to miss him. - Lois Lindberg

(Novel Ecosystems cont. from cover)

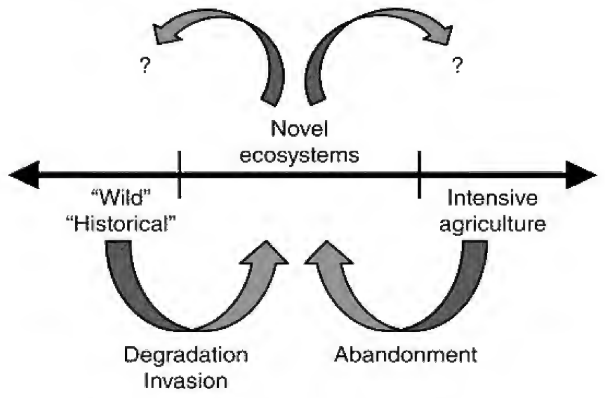

Figure 2. Novel ecosystems arise from the degradation and invasion of 'wild' or natural/seminatural systems or from the abandonment of intensively managed systems (Hobbs et al. 2006).

often do need management for conservation purposes and/or human needs.

How abundant are novel ecosystems?

Using the definition "unused lands embedded within agricultural and urban regions" novel ecosystems were mapped as occupying about 50% of the terrestrial ice-free globe 100 years ago (Figure 3) and wildlands 20–30% (mostly barren or sparsely tree covered). The remainder was lands used by people for settlements, cropland and rangeland. Unused fragments of land are likely to develop in novel ways as a result of invasion by new species and altered microclimate around the edges as well as by transient human uses. Due to recent increased conversion of both wild and novel ecosystems into human-used lands, novel ecosystems today may only occupy about 32% of the earth (Perring and Ellis 2013).

Novel ecosystems of comparable extent also exist in freshwater, estuarine and marine ecosystems, but my focus in this article is on terrestrial ecosystems and the impacts of invasive plant species.

The Anthropocene

Humans dominate the earth and have transformed the earth's land cover, climate, biogeochemical cycles, species distributions and abundance. The current geological epoch is commonly known as the Anthropocene – the age of man – in which biomes are "human systems, with natural ecosystems embedded within them" (Ellis and Ramankutty 2008).

Proponents of the "Anthropocene" idea think there is essentially no nature untouched by humans, and that ecosystems have been changing for millennia and will continue to change. From their point of view the term "novel ecosystems" applies to the whole planet, but might be useful as a rebranding effort and propaganda tool (i.e. novel ecosystems should be valued). They hope that the novel ecosystems concept "…can help embolden restoration ecologists to use new tools and new goals, and shake off the yoke of history" (Marris et al. 2013).

On the other hand many ecologists think that the rapid and extreme changes in land use, biogeochemical cycling and climate brought about by humans push us into a new and altered world where the concept of novel ecosystems is useful. Both groups make some good points but I agree with the latter group that the concept of novel ecosystems has practical value. I also share their recognition that between completely novel ecosystems on one extreme and totally wild ecosystems (if they still exist) on the other extreme lie hybrid ecosystems falling along a continuum of varying degrees of novelty.

I strongly recommend that we approach novel ecosystems with an open mind unconstrained by preconceptions or ideology. However, having an open mind does not mean we should accept all novel ecosystems with open arms. We need to fully understand the deficiencies as well as the benefits of novel ecosystems and their implications for conserving nature and supporting people.

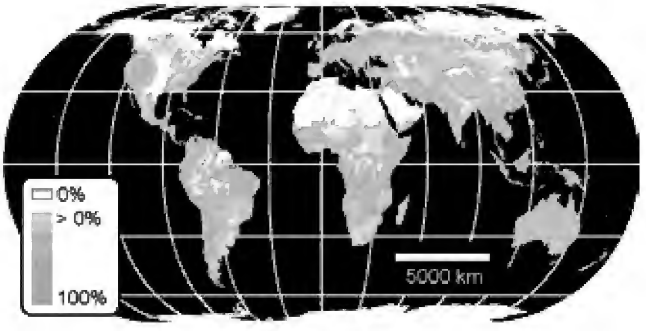

Figure 3. Extent of Novel Ecosystems AD 2000 (Ellis et al. 2010) White areas are wild (arctic tundra or deserts) or extensively altered by people (e.g. Midwestern USA). From: http://ecotope.org/blogs/image.axd?picture=potential_novel_ecosystems.png

Biodiversity and Ecosystem Function

We need definitions of some basic terms in ecology because they are important for the discussion that follows:

- **Ecosystem processes** regulate the amount and movement of energy and matter such as photosynthesis and biomass production by plants, prey consumption by animals, cycling of nutrients in soil, creation of soil, decomposition, and disturbance cycles (e.g. fire regimes, flooding).
- **Ecosystem functions** includes ecosystem processes but also refers to how all the species and processes interact and work together in the whole ecosystem. Examples include carbon storage, availability of light, production of reefs and burrows, and temperature maintenance.
- **Ecosystem services** are ecosystem processes or functions that benefit human welfare. Ecosystem services can be regulatory (e.g. climate stability, flood control), provisioning (e.g. food, timber, water), supporting (e.g. pollination), and cultural (e.g. recreation, esthetics, tradition, community).

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- **Biodiversity** is the variation of life and can refer to the number and variety of species of plants, animals, insects and microorganisms, the genetic diversity of species, the diversity of the ecosystem functions the species carry out and the diversity of ecosystems within an area, biome or planet.

High biodiversity is good. Ecosystems composed of a diverse assemblage of species and a diverse mosaic of habitat patches across the landscape are the most efficient in taking up nutrients, recycling nutrients and carbon through decomposition, and producing new biomass. Many of the functions carried out by diverse ecosystems provide valuable and irreplaceable ecosystem services for people.

Increasing functional diversity (i.e. more specialist species) increases the likelihood of having species that respond differentially to widely varying conditions (e.g. droughts, floods, severe weather, disease outbreaks). Functional diversity stabilizes ecosystem processes in response to change and supports ecosystem resilience, stability and ecosystem services. This functional redundancy is also known as the "insurance hypothesis." No matter what happens there are some species that can respond and damp down wild fluctuations.

Invasive species

Non-native (introduced; alien; exotic) species are nearly ubiquitous in ecosystems today. Fortunately only a relatively small percent become invasive, i.e. they establish, spread widely, and in a policy/regulatory sense, cause "harm" by significantly changing ecosystem species composition, diversity, structure and/or processes. Up to 12% of non-native vascular plants are thought to become invasive in the United States. In New York State 4.8% of the 1,300 persistent non-native plants were assessed as invasive but this number may rise as the number of plant species categorized as persistent falls (M. Jordan, unpubl. data; D. Werier, pers. comm.).

It is well known that invasion by non-native species of all kinds (plants, vertebrates, invertebrates, microbes) may cause large changes to many functions in all kinds of ecosystems. Invasive plants in particular are considered as builders and shapers of novel ecosystems. On average the abundance, growth, diversity, nutrient uptake and biomass of resident plant species decrease substantially as the proportion of non-native plant species increases. Thus the greater the abundance and impacts of invasive plants the greater is the likelihood that ecosystems – and food webs – will be greatly affected.

The forgotten food web unravels

The impact of non-native plants on higher trophic (food web) levels is one of the least-studied areas of invasion biology. Plants obviously are the essential sustaining center of food webs. Through the process of photosynthesis, plants use energy captured from sunlight to transform carbon dioxide, nutrients and water into plant biomass and produce oxygen as

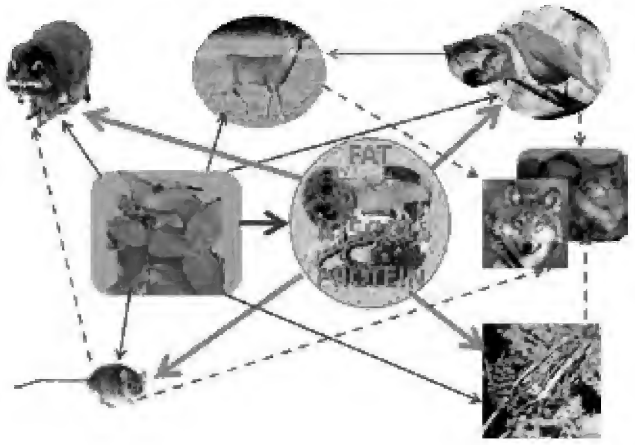

Figure 4. A simple food web showing the importance of insects in transforming plant material into food for many other animals.

a by-product. Next in line are herbivorous insects, the largest taxon of primary consumers. Herbivorous insects convert plant material of low caloric density into nutritious packages high in proteins, healthy fats and nutrients that are essential for the growth and reproduction of many species of animals, including carnivorous insects, birds, and mammals (Figure 4). Bugs – lots of bugs – were the real "paleo diet" eaten by early humans for 2.5 million years prior to development of agriculture.

Plants have evolved various defenses to protect themselves from being eaten, including chemicals such as glycosides, phenols, terpenes and alkaloids (Tallamy 2007). More than 90% of herbivorous insect species are specialists. That is, they feed on plants in fewer than three different plant families with which they share an evolutionary history and thus have evolved a tolerance for the specific chemical compound(s) and physical defenses of their host plants. Even generalist species can use only a small number of plant species.

Short-term adaptation of plants and animals that lessen impacts of invasive species is known. However evolution to fully restore functional ecosystem diversity from the bottom up could take millennia. For example, after 300 years in North America, *Phragmites australis* hosts only five species of herbivores compared with the 170 species that consume it in its native habitat. As species become increasingly rare, dispersed or extirpated the diverse genetic material needed for evolution and adaptation to change is lost. [Ed. Note: See also LIBS Newsletter vol. 7, no. 2 (Mar-Apr 1997) for an article on the insects of *Phragmites*.]

Thus, "When we build novel ecosystems – a hodgepodge of plants from around the world that have no evolutionary history with our local insects – we risk losing 90% of our insect herbivores!" (Tallamy 2013). The many other animal species that depend on insects for food and pollination would also be at risk. Complex food webs could become simplified and collapse. Those of us old enough to remember the high "bug splat" density on vehicle windshields ~40 years ago can confirm that insect abundance appears much reduced today, though increases in non-native plants are probably not the only cause.

Figure 5. Foreign origin of popular landscape plants. Used with permission from Dr. Douglas Tallamy, University of Delaware.

Disappearing specialist insects are not the only under-appreciated aspect of novel ecosystems. Interrelationships of below-ground organisms with above-ground organisms and ecosystem function also poorly known. Microbial diversity and functions are known to be very important, but only recently has the idea that human health is linked to environmental and microbial biodiversity and been recognized (Jordan 2013). If this link is confirmed by continued research, we may learn that the high incidence of asthma and other immune diseases in cities is in part due to the limited distribution of, and low plant and microbial biodiversity in, urban (novel) green spaces.

Different attitudes about novel ecosystems

A friend of mine told me that once he was happy to see nature surviving in vacant lots covered with dense, vigorous vegetation. Now – thanks to me – he knows they are just a bunch of weeds! This anecdote gets to the heart of an ongoing controversy about novel ecosystems: Are they scrubby, untended, feral, worthless weed patches? Or are they valuable functional habitats that rival their "pristine" counterparts and produce ecosystem services for people? In other words, should we love these novel creations of man as is, or try to "fix" them to better suit our desires and perceived needs?

The "all ecosystems are novel" camp thinks that altered ecosystems are worthy and beautiful, and welcomes all species into their ecosystems regardless of nativity as long as these species are useful and do no obvious harm. In the other camp are many traditional conservation biologists and restoration ecologists who fear the loss of biodiversity and treasured species in novel ecosystems and champion aggressive eradication and control of weedy invasive plants and animals. So which camp is right? I take the middle ground and hope that the extreme positions I described are an exaggeration.

Yes we need to adjust to a "new normal" in which we recognize that novel/hybrid ecosystems do have value, and then we must make the best lemonade out of these lemons that we can. What choice do we really have? Novel ecosystems are everywhere and as we now know they occupy about one third of the ice-free earth's surface. Novel ecosystems certainly are better for preserving nature than the alternative which increasingly appears to be conversion to "used" lands.

However I have some serious concerns. For example, very few studies have investigated the importance of specialist insect species in food webs, whether these insects really are disappearing in novel ecosystems and what the consequences may be. We should not leap to premature and sweeping conclusions about the value of novel ecosystems, as novel ecosystem science is still a young "work in progress."

I think we do need to manage some novel ecosystems to maintain biodiversity of native species and functional food webs where we can, but we need to be realistic about what goals and management approaches are appropriate and likely to succeed.

So what do we do about novel ecosystems?

On the local site scale our options are limited. Attempting classic restoration to undo extensive novelty and recreate a historical ecosystem has been likened to trying to put toothpaste back into the tube. Environmental conditions and species compositions have changed so radically that return to the past is impossible or would be exorbitantly expensive and require maintenance in perpetuity. A good example is the weedy shrubland/woodland on former potato fields in Wicks and Froelich farms County Parks in Huntington which could never be returned to historic native forest.

The best approach may be large scale strategies for managing the landscape matrix in which conservation sites and "unused" lands are embedded. Strategies should be directed towards reducing the human impacts that are driving the replacement of native species with non-native species. Prevention should always be the first priority.

- Allow sale of only non-invasive plant species and cultivars. Laws regulating the introduction of new potentially invasive species, and reducing the sale and spread of non-native species that are already present, are in place in Nassau and Suffolk Counties and also at the national level. Final regulations for New York State will be released later in 2014.
- Encourage use of more native horticultural plants in landscaping, especially woody species that support the most native insects. Most horticultural plant species used today are non-native and half of these are invasive (Figure 5).

Remove or reduce human-caused degradation. Nature can be resilient if given a chance.

- Limit land clearing; redevelop brownfields instead of clearing established vegetation.
- Encourage/legislate reduced use of fertilizers.
- Reduce nitrogen deposition in rainfall from fossil fuel burning.
- Upgrade sewage treatment plants and septic systems to

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reduce the amount of nitrogen discharged into groundwater, streams, bays and estuaries.

• Manage for connectivity so species can spread and migrate.

Level the playing field so native plants can be more competitive with non-native plants.

• Reduce white-tailed deer populations. The single greatest threat to eastern forests today is excessive browse by overly abundant deer. Deer preferentially browse native plants and tree seedlings and saplings. Heavy browse allows invasive plant species and a few unpalatable species such as sedges (Cyperaceae), black huckleberry (*Gaylussacia baccata*) and hay-scented fern (*Dennstaedtia punctilobula*) to dominate. In the absence of excessive browse, native wildflowers are much more competitive with invasive plants, and trees can regenerate.

• Use biocontrol agents but only if they have been rigorously tested for non-target impacts. Many invasive plants can aggressively spread because they have left behind the herbivores and diseases that kept them in check in their homeland. Thus introduction of thoroughly tested specialist insects and pathogens from their homeland can restore some balance and reduce invasive plants to tolerable levels. Then native plants should recover in the absence of other problems (e.g. too many deer). If some native species have been eliminated or drastically reduced, reintroduction may be necessary.

Conservation in the Anthropocene

I have been reading, learning, thinking and talking about novel ecosystems for four years now, and experiencing them (though unknowingly) for far longer than that. Novel ecosystems intersect so many different areas that it has been a challenge to integrate them in my mind and develop a coherent overview to share with others.

Dearly held human values, ethics and norms about nature underlie and shape peoples' attitudes and how they respond to change, including novelty and novel ecosystems. Positions have become quite polarized over the future of conservation in the Anthropocene (Marris et al. 2011; Lalasz et al. 2012).

I am still uncertain of my opinions about some aspects and claims about novel ecosystems in the Anthropocene. The science is so heavily fraught with emotion and passion and the antagonists have far greater experience than I do. However I am sure that we humans have a responsibility as a species to care for and protect the earth and all of the life it supports.

In closing I will share a quote from Marris et al. (2011). Although I don't necessarily agree with every detail of what she and her colleagues claim, I do appreciate their message of hope – and hope they are right.

"Yes, we live in the Anthropocene — but that does not mean we inhabit an ecological hell … The Anthropocene does not represent the failure of environmentalism. It is the stage on which a new, more positive and forward-looking environmentalism can be built. This is the Earth we have created, and we have a duty, as a species, to protect it and manage it with love and intelligence. It is not ruined. It is beautiful still, and can be even more beautiful, if we work together and care for it."

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Field Trips

APRIL 19, 2014 (SATURDAY) 10 AM
Coffin Woods, Locust Valley, Nassau Co., NY
Trip leader: Carol Johnston
Email: johnfjohnston2@optonline.net

Coffin Woods Preserve is a 70-acre mature oak/beech, tulip-tree woodland. Besides our native trout lily, *Erythronium americanum*, there is a stand of the lavender European trout lily (*Erythronium dens-canis*), red trillium (*Trillium erectum*) in abundance, wood anemone (*Anemone quinquefolia*), Siberian geranium (*Geranium sibiricum*), and *Galax urceolata*, among other wild flowers. Rarely seen on Long Island is a healthy stand of strawberry bush (*Euonymus americanus*). The Preserve has been awarded a grant to eradicate a stand of the invasive hardy kiwi vine (*Actinidia arguta*). Work will begin this spring, and we will take a look at the affected area. The trails are easy. Bring a bag lunch.

Directions: Coffin Woods Preserve, part of the North Shore Sanctuaries, is located behind Portledge School, Duck Pond Road, Locust Valley, 0.7 mile east of the intersection with Piping Rock Road, and on the left. Enter the Portledge campus, go past the Lower School on the left, past the Middle and Upper Schools, and at the end of the parking lot you will see tennis courts. Park behind the tennis courts.

MAY 24, 2014 (SATURDAY) 10 AM
Christie Estate South (Muttontown South), Nassau County, NY
Trip leaders: Mike Feder and Rich Kelly
Email: mdfeder2001@yahoo.com

This is a former Winthrop estate, and the habitats include mixed upland woods, successional fields, and kettle hole ponds. Bring plenty of water, sunscreen, and insect repellent. This will be similar to a LIBS walk here in July of 2011, however, we will spend some time exploring a wet area of the field where some interesting plants were found last summer. This will be a long but easy walk with some optional wet walking. It would be best if you could carry your lunch. Please contact Mike prior to the trip.

Directions: Meet at the parking area for Nassau Hall at 1864 Muttontown Road, Syosset. By car only: From either the Long Island Expressway or Northern State Parkway, go north on North Broadway (Rtes. 106/107) in Jericho. Very soon after passing under Jericho Tpke., bear right onto Rte. 106 which is Jericho - Oyster Bay Road. Continue north for 2.2 miles and turn left onto Muttontown Road/Eastwoods Road. Go west 0.4 mile and turn left at Nassau Hall. If the gate is locked, backtrack a few feet and take the driveway that goes through the building.

JUNE 7, 2014 (SATURDAY) 9 AM

Jamaica Bay Wildlife Refuge, Queens Co., NY
Trip leader: Richard Stalter
(Co-listed with the Torrey Botanical Society)

Jamaica Bay Wildlife Refuge encompasses 3,705 hectares. The refuge is part of the Gateway National Recreation Area, the country's largest urban national park. Although much of the natural environment has been modified by grading and filling, remarkably, many native plant species have been preserved.

Directions: Meet at the Jamaica Bay Wildlife Refuge Visitors' Center. By car: From Brooklyn – Belt Pkwy. (east) to exit 17 (Cross Bay Blvd.) go over North Channel Bridge and continue 1 mi. past the bridge at the traffic light to the entrance to the Refuge on the right. From Rockaway – Take Crossbay Bridge (94 St.) and go through Broad Channel Community. Refuge visitor center is about 0.5 mi. on the left. By public transportation: train: Take the A train going to Rockaways. Exit at Broad Channel Station. Walk west to Crossbay Blvd. then north, (right), about 0.5 mi. to the refuge. By bus: take Green Bus Line Q21 from LibertyAve. (Queens) to 116th St. (Rockaway) to the refuge; or take Triboro Q53 bus from Roosevelt Ave./Jackson Heights. Exit at refuge stop. You can also take the Greenline Q21 from the intersection of Woodhaven and Liberty Ave. Exit at refuge entrance.

JUNE 14, 2014 (SATURDAY) 9 AM
Appalachian Trail, Dutchess County, NY
Trip Leader: Rich Kelly
Email: vze2dxmi1@verizon.net

We will hike the Appalachian Trail and pass through at least 9 different ecological communities, so plant diversity should be great. We will make a particular effort to look for *Spiranthes lucida*, shining ladies'-tresses. There should be plenty of birds and insects to observe as well. Bring lots of water to carry, insect repellent, sunscreen, and a hat. Bring lunch, but you do not have to carry it, as we will return to the cars to eat. In the morning we will do an uphill hike at a slow pace, and the climb is not particularly taxing. You will have to pass over 3 wooden stiles along the way. In the afternoon we will do a different uphill hike that is more strenuous, so you could skip out after lunch if you are concerned, and still would have seen a lot of plant species from just the morning.

Directions: Contact the trip leader to register and for meeting place directions.

Long Island Botanical Society
PO Box 507
Aquebogue, NY 11931

Upcoming Programs

April 8, 2014* **Tuesday, 7:30 PM**
Andy Greller: "Natural History of Romania, Including Birds of the Danube Delta" This eastern European country, with landscapes ranging from the beautiful Carpathian Mountains to the extensive marshes of the Danube Delta, has a recorded history going back to Roman times. It was part of the Roman Empire known as Dacia. Its folk traditions encompass a number of cultures, all with colorful costumes and many with colorful characters, such as Vlad the Impaler (Dracula to us). We take particular note of the variety of natural vegetation and the abundant bird and animal life. Andy is Vice President of LIBS, Past President of the Torrey Botanical Society, Professor Emeritus in Biology at Queens College - CUNY, and also our senior world traveler.

Location: Bill Paterson Nature Center, Muttontown Preserve, East Norwich

May 13, 2014* **Tuesday, 7:30 PM**
Marilyn Jordan: "Novel Ecosystems" Novel ecosystems exhibit new combinations of species resulting from human actions such as prior cultivation, nitrogen addition, introduction of invasive species, pollution, overharvesting, and land disturbance. Opinions are divided on whether these altered ecosystems are worthless weed patches or valuable habitats. We will examine the implications of novel ecosystems for genetic and species diversity, trophic linkages, and ecosystem function, and the need to accommodate differing values and world views of stakeholders and policy makers. Marilyn got her BA from Queens College and a PhD in plant ecology from Rutgers University. She retired in January 2014 as Senior Conservation Scientist for The Nature Conservancy after a career studying invasive plant species, fire ecology, nutrient cycling, and more.

Location: Museum of Long Island Natural Sciences, Earth and Space Science Building, Gil Hanson Room (Room 123), Stony Brook University, Stony Brook

June 10, 2014 **Tuesday, 5:30 PM**
(please note early start time for the barbecue)

Annual Barbecue: The annual barbecue, featuring Chef Eric's made-to-order hot dogs and hamburgers. Salads, deviled eggs, desserts, etc. gladly accepted. The traditional location - on the green behind the Muttontown Preserve meeting house.

Location: Bill Paterson Nature Center, Muttontown Preserve, East Norwich

* Refreshments and informal talk begin at 7:30 p.m.
Formal meeting starts at 8:00 p.m.
Directions to Muttontown or Stony Brook: 516-354-6506